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ABSTRACT

Recent literature on the acquisition of "more" and "less" is reviewed with special emphasis on some key issues. The overriding goal of studies in this area has been the discovery of the developmental sequence that the child follows in acquiring "more" and "less," and, more generally, all comparative structures. The earliest empirical studies on this area provided some initial evidence that "less" means "more" for young children. On the basis of these empirical findings, the investigators, along with others, concluded that "less" and "more" are synonyms for children at some immature point in their development. However, contradictory empirical evidence indicated that at least some groups of children do not treat "less" and "more" as synonyms. Because of the discrepancies found between some of the studies in children's responses to "less," investigators became more aware of the possibility that the type of task required of the child may influence the accuracy and type of responses. It is suggested that "less" is never synonymous with "more" for a child. There is some evidence that the non-linguistic response bias of choosing the greater of two amounts coincides with not knowing "less." Virtually all the studies conclude that children learn "more" before "less." It is concluded that the acquisition of an adult-like understanding of "more" appears to take years of development. (SW)

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THE ACQUISITION OF MORE AND LESS: A Critical Review

V. C. Mueller Gathercole

Recent literature on the acquisition of more and less is reviewed with special emphasis on some key issues. An attempt is made to draw the available data together in order to gain a comprehensive overview of the developing acquisition of these items. Some directions for further research are suggested, particularly with reference to understanding the development of more.

In recent years, a great deal of research has focused on the child's developing understanding of some of the linguistic forms that Donaldson and Wales (1970) refer to as "relational terms that involve comparison" (238). These terms include such linguistic structures as more and less, X-er, X-est, X enough, too X, as X as, and also relative polar opposites like big-little and tall-short. Of these, more and less have been of some prominence. The acquisition of more and less has been the subject of intensive research and has played a predominant role in the formulation of major theoretical positions, such as the Semantic Feature Hypothesis [E. Clark 1973a, 1973b, 1975, H. Clark 1970].

In the many studies of more and less, a variety of questions have been raised and explored. Often the data and key issues of one study are not directly comparable to those of another. Nevertheless, we can assert that the major overriding goal has been the discovery of the developmental sequence that the child follows in acquiring more and less, and, more generally, all comparative structures. In order to achieve an understanding of that developmental sequence, it is important to know the meanings of more and less for the child, so much of the research has concentrated on those meanings. In our review of the literature, we will group the studies into three main sections.

(1) The first section deals with early studies on more and less. In early studies of this positive-negative pair, children were observed to respond incorrectly to the negative member as if it were the positive member in comprehension tasks. Because of this, investigators proposed that there might be a stage in the child's developing understanding of these terms when the negatively specified member of the pair is understood as the positively specified member, so that the two items are synonymous for the child.

(2) The second section deals with studies which questioned the validity of this proposal. Some researchers raised questions about the motives behind children's responses--were they linguistic or non-linguistic? Others voiced concerns about the influence of the nature of the particular task used to elicit children's responses. Still others produced evidence which conflicted with the initial theory.

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(3) The third section deals with conclusions we might draw concerning the developmental sequence the child follows in acquiring more and less.

Initial Hypothesis: Less means "More"

The earliest empirical studies on more and less provided some initial evidence that less means "more" for young children. The study that apparently gave impetus to all of the studies on relational comparatives, but especially to those on more and less, was that reported in Donaldson and Balfour (1968). In their well-known study, children were presented with two cardboard trees on which cardboard apples could be hung. Children between 3;5 and 4;1 were given various active and passive (judgmental) tasks in several different contexts, in which the number of apples on the two trees varied. The active tasks included such instructions as to put more (less) apples on one tree than the other, and the passive tasks asked the child to judge "Does one tree have more (less) apples on it than the other?" and to state "Which tree has more (less) apples?" (Donaldson and Balfour 1968: 463).

The most obvious finding of this study was that the children largely responded to less as if it meant "more." That is, for example, when the children were confronted with two trees with equal numbers of apples and were asked to make one of the trees have less apples than the other, the children frequently placed additional apples on the tree, making it have more, rather than less, than the other tree. Or when asked of two trees with unequal numbers of apples, "Which tree has less apples on it?" the children often picked the tree which had a greater number of apples on it. Donaldson and Balfour (1968) concluded:

> 'less' is understood to refer to quantity but . . . it remains largely undifferentiated from 'more', with 'more' as the consistently dominant interpretation for the undifferentiated pair. (468)

In several studies subsequent to Donaldson and Balfour's, the findings that more and less are not discriminated by young children found additional support. Interested in measuring the correlation between children's knowledge of more, less, same, and different and their cognitive development and performance on conservation tasks, Harasym, Boersma, and Maguire (1971) tested 85 first-, second-, and third-graders on six conservation tasks to arrive at a population of 20 non-conservers, 20 intuitive conservers, and 20 logical conservers on the basis of their individual scores. Then the investigators administered a semantic differential test to these 60 children to test their understanding of more, less, same, and different. They asked children to rate these words, plus mother and school, on twelve scales, six "concrete" and six "abstract." The six concrete scales, which Harasym et al. felt provided the "relevant opportunities for meaning discrimination" (772) were "low-high," "long-short," "wide-narrow," "big-small," "thin-fat," and "up-down."

The results from the semantic differential revealed that the non-conservers did not distinguish between more and less, the intuitive conservers treated the two terms as different but not opposites, and the logical conservers treated more and less as opposites. The conservers' responses to less resembled the non-conservers' responses to more and less; the difference between these two groups lay in the conservers' responses to more.

David S. Palermo (1973) also found support for the Donaldson and Balfour findings that more and less are not discriminated by young children. In his study, he administered two experiments. The first experiment was designed to be similar to Donaldson and Balfour's apple experiment, but included a test of a continuous substance (water) as well, and tested two age groups (mean ages 3;9 and 4;8). The second experiment, on a different population of children (32 children from Kindergarten, first, and second grades) examined the correlation of the results found in such a Donaldson and Balfour study with a semantic differential analysis like that of the Harasym et al. experiment.

Palermo found in the first experiment that most of the children performed very well on more, making fewer than 5 errors each, out of 38 trials. But their performance on less was either very good or very poor. Those children who appeared to know less (4 of the younger group and 5 of the older group) made an average of 2.7 errors, while the rest, who didn't know less, made an average of 2.5 correct responses out of 38, treating less as if it were a synonym of more.

In Palermo's second experiment, he followed the same procedures as described above, except that semantic differential analysis followed the more and less manipulations. In the semantic differential analysis, Palermo had the children rate funny, more, less, and same on the same six concrete scales as those used by Harasym et al. Palermo reports that the children who treated less as more in the first part of the second experiment treated less as more in the second part. Those children who demonstrated a knowledge of less in the first part, differentiated more and and less on the semantic differential and treated more in the semantic differential the same as the former group treated both more and less. They treated less differently, such that the semantic differential profile for less changed from the first group to the second. Palermo points out that the common treatment of more and less by the children who do not know less is consistent with the previous findings of Harasym et al. (1971). However, he adds, the results in the Harasym et al. study, contrary to those in Palermo's, show the profile for more changing from the first group to the second.

On the basis of empirical findings such as these, the investigators, along with others, concluded that less and more are synonyms for children at some immature point in their development. H. Clark (1970) proposed that more and less originally both mean "quantity of" or "some" (272). Subsequently, the best exemplar of the "some" meaning is taken to be whatever object has the most extent. And, finally, "more and less are at last used in their true comparative meaning" (H. Clark 1970:273), with less applying to the less extended end of a scale.

E. Clark (1973b) formalized the synonymity of less with more in terms of her Semantic Feature Hypothesis. Her original position was that at the first stage described by H. Clark (1970), both more and less are specified in the child's lexicon as meaning /+Amount/. At the second stage the feature /+Polar/ is added to the semantic features of the two words, leading to a correct semantic description of more, but an incorrect understanding of less. Then, at the final stage, the child learns that less is specified as /-Polar/ instead of /+Polar/ (E. Clark 1973b: 91).[2]

Reservations About the Less is "More" Theory

The Interference of Non-Linguistic Response Strategies. In later modified versions of her Semantic Feature Hypothesis, E. Clark (1973a, 1975) has pointed out the difficulty of interpreting children's "less is more" responses. It is possible that such responses arise, as she first hypothesized, from the child attributing all the semantic features appropriate for more--i.e., /+Amount, +Polar/--to both more and less. Clark refers to this hypothesis as the Full Semantic Feature Hypothesis. However, such responses could also arise from the child having only an incomplete semantic representation--/+Amount/--for both more and less. According to this Partial Semantic Feature Hypothesis, this incomplete linguistic knowledge is coupled with a "non-linguistic strategy of choosing the greater of two or more amounts, or of choosing objects with greater extension along dimensions like height or length" (E. Clark 1975: 87). The combination of partial linguistic knowledge with such a non-linguistic preference would lead the child to respond correctly to instructions involving more, but incorrectly to those with less, always choosing for both the object or array which was greater in amount.

Several investigators have accepted (Holland and Palermo 1975, Townsend 1974) and have documented (Trehub and Abramovitch 1977, Weiner 1974) such a non-linguistic response bias. In one study, Trehub and Abramovitch (1977) administered three types of tests to 18 three-year-olds (mean age 3;11). The first type ("Point More-Less") was a task in which the subject was asked to point to the one of two non-linearly arrayed piles of objects that had more (less) objects. In the second task ("Animal More-Less"), the subject was asked to make a toy horse (cow, etc.) run to (jump over, etc.) the pile of items (of 2 piles) that had more (less) toys. Finally, subjects were given two piles of objects and were asked to point to one of them ("Point Any"). These investigators' results showed that the ten children who made any errors at all pointed to the array with more items 87.5% and 92.5% of the time in the "Point Less" and the "Animal Less," respectively. These children also chose the pile with more items in the "Point Any" task 91% of the time. Statistical analysis of these results indicated that these children's responses were independent of task instruction. On the other hand, children with no errors on either of the more/less tasks chose the larger array in the "Point Any" task only 68.75% of the time, a non-significant response bias.

The authors believe that the former group of children do not understand less as "more," but "concur instead with E. Clark's (1973a) revised view that children's predilection to act on the world in particular ways has simply been misinterpreted as a case of semantic overextension" (165).

In another study, Susan Weiner (1974) conducted a similar experiment in one of three experimental tests administered to young children. In this experiment, Weiner merely asked 24 of her younger subjects (mean ages 2;7 and 2;8) from two previous experiments to pick one of two unequal rows. She reports that the children were more successful in picking the "more" row here than overall in the two more/less experiments she had performed for the same study. In addition, the responses of those subjects who had done the second experiment were very similar to responses to more in the second experiment.

Contradictory Empirical Evidence. It is thus possible for children to produce "less is more" responses either by assigning /+Amount, +Pol/ to both more and less or by combining linguistic knowledge that more and less are (partially) specified as /+Amount/ with a non-linguistic preference for the greater of two or more amounts. In either case, we could expect all children at some time in their development to treat more and less exactly the same in their response patterns and, in comprehension tests like those described above, to perform very poorly on less. One could predict that at least some such children could be found in each study. The greater the number of children responding poorly on less, treating it as more, the more support there would be for the Full or the Partial Semantic Feature Hypothesis. However, it is clear from several studies that, even though there is evidence of a strong non-linguistic bias for choosing the larger of two arrays, at least some groups of children do not treat less and more as synonyms.

One study in which less was not understood as "more," and which appeared even before the Donaldson and Balfour study, was that of Griffiths, Shantz, and Sigel (1967). The primary concern of Griffiths et al. was investigators' reliance on the terms more, less, and same in conservation tasks without knowing what these terms mean to the children. In their study, they presented children between 4;1 and 5;2 (mean age: 4;7) with sets of objects to test their use of more, less, and same for number, length, and weight. In each trial, a child was shown two sets of objects and was asked "What can you tell me about these two (sets of) lollipops (pencils, blocks)?" If the child did not respond with same, more, or less, he was then asked "Are these two sets of lollipops (etc.) the same or are they different?" Then, if he still did not respond, the child was asked, "Does this set of lollipops (etc.) have more lollipops, less lollipops, or the same number of lollipops as this set . . .?", and, finally, "Point to the set with more (less) lollipops (etc.)" (843). Their results showed that the children comprehended less almost as well as more, with overall accuracies of 85% and 88%, respectively.

Another who has reported findings conflicting with those of Donaldson and Balfour is Susan L. Weiner (1974). Weiner conducted two experiments to test various hypotheses about the meanings of more and less for young children. In the first experiment, children were asked to judge which of two linear arrangements had more (less) items in three conditions: (1) one in which the experimenter made two equivalent lines unequal by addition, giving more in one line than the other, (2) one in which the investigator made two equal lines unequal by subtraction, giving fewer in one line than the other, and (3) one in which two unchanged lines had unequal numbers of items in the rows. The second experiment was essentially the same, except that the two lines always started with unequal rows of items, and two extra conditions were added; (4) one in which addition led to fewer items in the affected row instead of more, and (5) one in which subtraction led to more items in the row affected instead of fewer. Both experiments were performed on two different age groups, the younger groups having mean ages 2;7 and 2;8 for experiments one and two, respectively, and the older groups having mean ages of 3;9 and 3;6, respectively.

Contrary to the "less is more" studies, Weiner found, among other things, that more and less were not confused by her subjects. Rather than responding at a worse than chance level on less, which is what one would expect if less meant the same as more, the children responded at chance or better than chance on less for both her age groups.

Weiner does note, however, that she did get some "less is more" responses in the first experiment by her older group (mean age: 3;9). In six out of eighteen less trials, these children pointed to the row with more. But Weiner is quick to point out that in this group, the children tended to point to the row even before they were asked any question. She believes this "less is more" phenomenon reflects a preference for or a perceived salience of longer rows by 4-year-old children.

A failure to confuse less with more is also reported in Wannemacher and Ryan (1978). Wannemacher and Ryan tested 45 children (divided into three age groups with mean ages of 3;2, 4;3, and 5;2) on six different tasks for their understanding of more and less. (These are further described in detail on pp.). Four of these tasks involved concrete stimuli; two did not. For none of these tasks was there any indication that the children treated less as more. There was no task in which the responses were either worse than chance or clearly of the "less is more" variety. Children's responses to less were in some cases much better than chance, indicating some knowledge of less. In cases where the responses to less were at chance level, indicating that the children did not know less, their responses were either inconsistent, choosing one time the response which corresponded to more, another time the one corresponding to less, or no response or "I don't know." The latter type of error on less was the usual type of error in those tasks in which no response alternatives were provided.

The above studies which have shown that some children, at least, do not respond to less by adding objects or by choosing the array with more objects undermine a theory that attributes either an incorrect

lexical entry /+Amount, +Pol/ or an incomplete lexical entry, /+Amount/, to less, since

> one of the main sources of evidence for the incomplete (or incorrect) lexical entry hypothesis [was] . . . the child's treating less as if it mean more . . . . (Carey 1978a:127)

To this lack of evidence, Carey (1978a) has added particularly convincing positive evidence that there is never a stage when less has an incomplete or incorrect feature specification in the child's lexicon.

In her study, Carey performed two experiments to discover if children who did not know less treated it differently from a nonsense syllable tiv. In the first of these, 65 three- and four-year-old children were shown a glass partly filled with blue water ("tea") and a "fussy puppet" who was not satisfied with the level of the water and wanted the children to fix it. Half of the children were first administered a "Finger Adjustment Condition" in which the puppet pointed to the desired level on the glass. Then all the children were shown a different "fussy puppet" who verbally indicated the desired amount of liquid. He asked the child to make it so there was more or less or tiv tea in the glass. Carey reasoned that one could determine whether or not children had access to a lexical entry for less by comparing their responses to less with those to the nonsence syllable tiv. If children's incorrect responses to less consisted of adding water much more frequently than their responses for tiv, then the children must be looking up and making use of an incomplete or incorrect mental lexical entry for less in responding. In such cases, the child could be expected, in response to tiv, either to not respond or to ask for clarification ("What's tiv?"). If the number of addition responses for less turned out to be equivalent to the number of addition responses for tiv, then the child is probably not consulting a lexical entry for less, but, rather, responding on the basis of the sentence frame "Make it so it's _____" combined with a non-linguistic response biac to add.

Carey identified six basic patterns in the children's responses to the four requests (tiv, more, less, tiv or tiv, less, more, tiv) made of each child. One pattern of responses (Carey's Group I, n=19/65) was to respond identically to all four instructions. Carey argues that children who responded in such a manner did not make use of lexical information in responding to either more or less. 41% of the 3-year-olds fell into this group, 21% of the 4-year-olds. A second pattern of responses (Group II, n=19/65) was adult-like, in that the response to more was one of adding, to less one of subtracting, and to tiv, one of questioning the meaning of tiv or not responding. Six of seven children who asked what tiv meant on the first tiv trial belonged to this group. 42% of the 4-year-olds and 11% of the 3-year-olds belonged to this group. A third pattern of responses (Carey's Group IV, n=10/65) was semi-adult like; the children added for more, subtracted for less, and either added for both trials on tiv or added on one trial and subtracted on the other for tiv.

The other three patterns of responses are the more important ones for determining stages of growth intermediate between ignorance of and adult-like understanding of more and less. The fourth pattern (Group III, n=7/65) reflected knowledge of more in that the children responded by adding, but a lack of knowledge of less, since they responded to less by making a response irrelevant to quantity or no response, which is exactly how they treated tiv on at least one of the tiv trials. The children in this group never added for less, which indicates further that they were not making use of any (either incomplete or incorrect) lexical information for less, treating it as a nonsense syllable. A fifth pattern of responses (Group VI) was the only clear case of the "less is more" phenomenon, in which both more and less produced a response of adding and tiv was treated as a nonsense syllable. However, only one child (of all 65) fit into this category. The sixth pattern of responses (Group V, n=9/65) was similar to this last one, in that the children added for less; but their responses for tiv were problematic, since on the first tiv trial, the children treated tiv as a nonsense syllable, and on the second trial, they responded by adding. The first response to tiv is consistent with the "less is more" hypothesis, but the second response is similar to the first pattern of responses (as in Group I), where more, less, and tiv were not differentiated. Carey felt that the children in Group V were not responding on the basis of some partial knowledge about less. She argues, rather, that it is no coincidence that all of the children in this group were tested on more before less, and contends that they were perseverating with the addition response they had given for more.

In order to pursue the question further, Carey conducted a second experiment. In it, children were shown a "chemistry set" with eight tubes of colored water. The amount of water in the tubes could be increased by squeezing a stop-cock above them and decreased by squeezing a stop-cock below them, minimizing a response bias to add. Children were asked to "make it so there is more (tiv, less) blue water in this one" (123). Carey hoped to avoid the ambiguity behind responses like those of the last group above (Group V) in two ways. First of all, the children were divided into two groups, one tested on more/tiv, the other on more/less. Carey argued that one problem with interpreting responses in Experiment one concerned the unequal positions of tiv and less in the four instructions and the low and unequal number of instructions for each verbal stimulus (2 for tiv, 1 each for more and less). In Experiment 2, tiv and less held equivalent positions in requests to children, such that some children only heard more and tiv instructions and others only more and less. In addition, each child received eight instructions on either more/tiv or more/less. If there is a stage at which there is an incomplete (or incorrect) lexical entry for less, comparison of the responses to tiv and less across these two groups should show more additions overall for less than for tiv. Secondly, any child in the more/tiv condition who asked any question at all about the meaning of tiv was told that tiv meant less. If such a child then responded to less by adding, then it would be clear that he differentiated tiv from less, and that he had some incomplete or incorrect

lexical knowledge of less. Thus, within this group, maximal response differentiation between tiv and less was encouraged.

The results of this second experiment helped confirm the suspicion that the nine children with ambiguous response patterns in Experiment I were most likely perseverating the response of addition. First of all, there were no more additions overall for less than for tiv. Secondly, of the eleven children who questioned tiv in Experiment 2, eight of them, when told that tiv meant less, subtracted for less; they did not add. Only one of the remaining three children proceeded to add for less and for more--i.e., only one child responded in a manner that is consistent with the "less is more" predictions.

Thus, only one child in each of Carey's two experiments could be classified as having either an incomplete or incorrect lexical entry for less.

Carey's findings that there is probably never a stage when less has a partial or incorrect lexical representation were substantially replicated by P. Gordon (1978). Following Carey, Gordon tested children on more, less, and tiv. Gordon performed two experiments on children aged 3;1 to 4;4 (Experiment 1) and 3;0 to 4;5 (Experiment 2) on pairs of stimuli that varied not only in amount, but also in features other than quantity, such as color and homogeneity. Gordon felt that if we provide the child with stimuli which are varied in ways besides quantity, we can observe how the child responds across instances in which quantity, but not other features, is changed. If the child always chooses the greater or lesser of the two amounts for instructions with less, this lends greater support to the Partial Semantic Feature Hypothesis that less means /+Amount/ than in previous studies, since there are other potential bases of choice.

In the two experiments, Gordon found that there was no significant difference in the consistency of responses to less and tiv. And there was only one child (out of 29) who clearly followed a "less is more" pattern of responses, choosing the "more" stimulus consistently. This is put into relief, however, by four subjects who responded consistently to tiv (19,20).

Looking back at the original Donaldson and Balfour (1968) study, there is even evidence there that their subjects too did not treat less and more as identical. Some interesting errors occurred when the children were confronted with two trees on which there were equal numbers of apples. Six of the fourteen children, when asked "Which tree has more apples?" responded with utterances like "Both of them," "Both the trees," and "Each tree." The discrimination of less from more by half of these 6 children is revealed in that three of them made a different kind of response to less than more. In this context of 2 trees with equal numbers of apples, they responded to "Which tree has less apples?" by simply choosing one of the trees.

The Problem of Task-Specific Responses. Because of the discrepancies found between some of these studies in children's responses to less, investigators became more aware of the possibility that the type of task required of the child may influence the accuracy and type of his

responses. Some investigators have directed their attention to the type of array presented and its potential influence on the child's responses. Weiner (1974) (See also Palermo 1973) suggested that one of the reasons why children in studies previous to hers confused less with more, while in hers subjects did not, might have been because of differences in the experimental stimuli used. In the Donaldson and Balfour (1968) and Palermo (1973) studies, the children were presented with non-linearly arranged numbers of apples, while in hers, the children had to judge relative lengths of rows, in which items were arranged in one-to-one correspondence. The children in her study were, thus, supplied with "visually more obvious, developmentally important cues to relative quantity" (Weiner 1974: 285). In the other studies, she adds,

> if the subjects understood that less was in some as yet unspecified way associated with more, a good guess might have been to choose the array with the greater number of toys. (285)

Palermo (1974), who had previously found no difference in children's responses to discrete and continuous substances (Palermo 1973), followed up on this suggestion and experimentally tested 32 children (divided into two age groups, mean ages 3;2 and 4;3) on four types of arrays: (1) unequal numbers of non-linearly arranged apples on apple trees, as in Donaldson and Balfour (1968) and Palermo (1973), (2) differing amounts of water in glasses of the same dimensions, as in Palermo (1973), (3) blocks of different weights, as in Griffiths et al. (1967), and (4) linear arrays of poker chips, as in Weiner (1974). He asked the children simply "Which X has less Y?" to determine if there was a significant difference in responses according to task type. His results showed no difference in responses from one type to another, contrary to Weiner's prediction. Palermo concluded that differences in children's responses to less from one study to another must be due to factors other than the type of array tested.

Nevertheless, even if the use of a linear vs non-linear array may not alone affect children's responses, there do appear to be other factors which can. For example, in a study reported by Donaldson and McGarrigle (1974), pre-schoolers (mean age 4;3) were asked to judge which of two shelves of cars had more cars on it. On one shelf there were five cars and on the other there were four. Under one condition, the cars stood alone on the shelves, and in the other, a row of six garages was added to the shelf with five cars, and a row of four garages was added to the shelf with four cars, such that each car was inside a different one-car garage. In the condition with the garages, fourteen of the forty children tested (and fourteen of the nineteen children making any errors at all) asserted that the shelf with four cars in four garages had more cars than the shelf with five cars in six garages, suggesting that the children were influenced by the relative fullness of the display with the garages, rather than the actual numbers of cars.[3]

The importance of the experimental context was further brought out very clearly in Wannemacher and Ryan (1978). In their study, Wannemacher and Ryan tested 3-, 4-, and 5-year-olds on six different tasks to assess the influence of procedural factors on the children's comprehension of less. In Task 1, the children were shown six different displays of beads on vertical rods, in which the number of rods in each display varied from three to six. The children were asked to identify a rod that had more (less, not more, not less) beads than a standard rod identified by the experimenter. In Task 2, children were asked two different sets of questions, without reference to any specific concrete stimulus. The first of these was (1) "What eats less, a horse or a bunny?" If the child answered "bunny," he was then asked (1a) "What eats less, a bunny or a mouse?" If the children answered "horse" to question (1), he was then asked (1b) "What eats less, a horse or an elephant?" The second set of questions was asked in a similar manner. First (2) "What makes less noise, a car or a train?" was asked, followed by (2a) "What makes less noise, a car or a bicycle?" or (2b) "What makes less noise, a train or a rocket?" depending on the child's answer to question (2). Task 3 was also performed without reference to a concrete stimulus. The experimenter simply asked the child, "Pretend you had to carry a bucket full of dirt, and it was really heavy. What could you do to make it so there was less dirt in your bucket?" In Task 4, two out of four dolls were used as stimuli for each of three different questions about which doll had "less hair" or "less clothes on." Task 5 involved a picture of two glasses, one empty and the other 2/3 full. First the child was asked to "Draw it so there's less water in this glass (pointing to empty glass) than in this glass (pointing to standard--2/3 full)." After finishing the drawing the child was asked (A) "How would you make it so there is less water in this glass (pointing to standard glass) than in this glass (pointing to child's drawing)?" and (B) "If you drank some of the water in this glass (pointing to the standard glass), would there be more or less left?" Finally, in Task 6, the children were shown two toy lambs, each on a square of green paper, one 2" square and the other 4" square, and were asked "Pretend that these . . . are fields of grass. . . . Which lamb has less grass to eat?"

Wannemacher and Ryan found that responses to less varied according to task. The 3-year-olds, on the whole, responded at chance level to less, except on Tasks 1 and question B of Task 5, in which they performed much better (90% and 87% correct responses, respectively). In contrast, 5-year-olds, in general, responded appropriately to less (87% to 100% accuracy), except on Task 2, question 2, where their responses did not differ from chance. The 4-year-olds showed more varying response patterns between tasks, but on the whole responded well (though never with 100% accuracy), except in Task 3 and Task 5, question A, for which their responses were at a chance level. Note that responses did not only vary across tasks, but also within tasks, as in the 5-year-olds' different treatments of questions (1) and (2) of Task 2, or the 3- and 4-year-olds' different treatments of questions A and B of Task 5.

There may be numerous contextual cues triggering such variations in response patterns. Weiner (1974) had suggested the influence of linear vs. non-linear arrays. Donaldson and McGarrigle's (1974) study suggested the influence of the relative completeness of the arrays. Differing results in Wannemacher and Ryan's (1978) study on the questions of Task 4 and questions (1) and (2) of Task 2 suggest also the potential influence of the NP used in the question (The choice of NP used in instructions has been shown to be influential in children's understanding of in, on, and under. See Grieve, Hoogenraad, and Murray 1977.) and of the child's knowledge of the world. For example, Task 4 involved judging "less hair" vs. "less clothes," and Task 2 involved knowledge of the size of animals and the amount of noise made by different vehicles. Besides these variables of context, Gordon (1978) has recently suggested that other features such as relative sizes of stimuli, relative homogeneity of color, shape and type of stimuli, and 2- vs. 3-dimensional stimuli may also affect children's responses (23).

In addition to the above features of the context, two other influential factors have been discussed in some detail by several researchers. These are the number and the explicitness of response alternatives made available in a test. These have been the primary source of some reservations about the results of studies on more and less, not so much because of their potential influence on the accuracy of responses[4], but because of our need to take the number of response alternatives into account when evaluating children's incorrect responses. The number of alternatives given the child is a critical factor to take into account before we can accurately assess the motivation behind the child's responses. In many of the more/less studies, the child has been offered two stimulus items--e.g., two trees with apples on them, two rows of balls, and so forth (Donaldson and Balfour 1968, Palermo 1973, 1974, Griffiths, Shantz, and Sigel 1967, Townsend 1974). It has been pointed out by several researchers (Kavanaugh 1976, Townsend 1974, 1976, Wannemacher and Ryan 1978) that in such a two-choice task, it is difficult to sort out "less is more" responses from merely incorrect responses to less. In such a two-item, or one-error, test, if the child responds to a question like "Which one has less?" by choosing the item with more, is it because he thinks less means "more," is it because he thinks less means /+Amount/, and the best exemplar of /+Amount/ is the item with the most, or is it because he does not know what less means at all, and merely responds by choosing the item with more items, either randomly or out of a non-linguistic preference for things with greater extent?

The same concern has been voiced (Townsend 1974) regarding three-item tasks in which one of the items acts as the standard of comparison. When this item is eliminated as a response alternative by becoming the standard, the task is reduced to a two-item task, and, again, "less is more" responses cannot be differentiated from merely incorrect responses to less.

Kavanaugh (1976) experimentally explored the possibility that "less is more" responses were an artifact of one-error tasks by administering such tasks along with two-error tasks to 3- and 4-year-olds (mean ages

3;6 and 4;7). The one-error tasks consisted of the experimenter presenting two static objects with unequal numbers of movable objects placed on or in them (two apple trees with unequal numbers of apples, two ledges with unequal numbers of checkers on them, and two tubes in which unequal numbers of golf balls were placed). The child was asked which X had more (less) Y. The two-error task was performed with the same stimulus objects, but the child was given four movable objects (apples, checkers, balls) and two empty static objects (trees, ledges, tubes). He was then asked to make one (identified) tree (etc.) have more (less) apples (etc.) than the other. Children's errors on the instruction with less could consist of putting more objects on the indicated static object than the other, or of placing equal numbers of objects on the two static objects.

Results on the one-error tasks were consistent with the "less is more" responses of earlier studies. Errors on more were minimal (1% and 6% for 3- and 4-year-olds, respectively), and errors on less were high (85% and 46%, respectively), always consisting of opposite choices, since this was the only error option.

However, errors on the two-error tasks were not consistent with the "less is more" hypothesis. Though the percentages of errors for less were equivalent to those of the one-error tasks, the types of errors were distributed fairly equally between errors of placing more objects, rather than less, on (in) the indicated static object and errors of placing equal numbers of objects on the two static objects. The latter type of error is not consistent with the "less is more" hypothesis. The lack of synonymity of less with more is, thus, easily detected in the two-error tasks, but masked in the one-error tasks.

In a similar vein, Wannemacher and Ryan (1978) contrasted tests in which response alternatives were made available to the child with tests in which no response alternatives were made available. An example of the latter type is their Task 3: "Pretend you had to carry a bucket full of dirt, and it was really heavy. What could you do to make it so there was less dirt in your bucket?" (See p. 109 for a description of the other five tasks in their study.) The authors argued, like Kavanaugh, that the two-item test does not allow a distinction between not understanding what less means and treating it as a synonym of more, whereas a test in which no response alternatives are provided will.

Unlike Kavanaugh's subjects, Wannemacher and Ryan's subjects did not give "less is more" responses even in the tasks with response alternatives. The 4- and 5-year-olds responded generally correctly to less, while the 3-year-olds performed either at chance or better than chance, depending on the task. However, in those tasks in which there were no response alternatives, only the 5-year-olds performed significantly better than chance. Errors of the 3- and 4-year-olds were not of the "less is more" type, but were, rather, consistently either "I don't know" or no response. Wannemacher and Ryan concluded,

> if the possible response alternatives are provided. . . [children] will readily pick one of the solutions offered . . . , however, when the possible answers are not given . . ., children are much less likely to guess. (667)

Synthesis: Overview of the Development of More and Less.

What conclusions can be drawn from the many studies reported above? What, in fact, have we learned about the acquisition of more and less and their meanings for young children? In this section, we will attempt to answer this question and to arrive at some synthesis of the knowledge gained from the studies on more and less.

Less is Never a Synonym for More. With the hindsight offered by so much experimentation, I think we can confidently state that less is never synonymous with more for a child, whether as /+Amount, +Pol/ or /+Amount/. A child either knows or does not know what less means. When he knows what less means, he responds appropriately. When a child does not know less, he either responds at chance, does not respond, or responds in accordance with some non-linguistic response bias, often a preference for choosing the greater of two amounts. The type of incorrect response depends to a large degree on the task at hand (e.g., with concrete stimuli vs. without concrete stimuli) and the number of response alternatives provided (two vs. more than two).

There is some evidence that the non-linguistic response bias of choosing the greater of two amounts coincides with not knowing less. In Trehub and Abramovitch's (1977) study, a response bias in favor of greater amounts in their "Point Any" task predominated in those children who did not know less in the "Point Less" and "Animal Less" tasks. This bias in the "Point Any" task did not show up in the responses of subjects who knew less. Trehub and Abramovitch are careful to point out that on the basis of their data "there is no way to ascertain whether the bias causes or results from inadequate comprehension" (166).

One deceptive factor in assessing children's understanding of less has been the confidence with which children respond to less as if it meant "more" (Donaldson and Balfour 1968, Donaldson and Wales 1970, Palermo 1973). It has been intuitively felt that the child will respond so confidently only if he is acting on the basis of linguistic knowledge of the word in the instruction. However, subsequent research has shown this to be a false assumption. It appears, instead, that if the child is provided with explicit response alternatives in an explicit context, he will readily respond, even if he does not know a word in the instruction. This is strikingly apparent in the performance of the subjects in Wannemacher and Ryan's (1978) study, in which subjects readily responded to less when concrete stimuli were present, but gave no response or said "I don't know" when there were no concrete stimuli. This fact is underscored further in Carey's (1978a) study. Carey reports that in her first experiment, a majority of the children (63% of the 3-year-olds and 53% of the 4-year-olds) responded without any comment at all to the first instruction containing the nonsense syllable tiv. Because 4-year-olds were twice as likely to respond without comment if they had been in the preliminary, nonverbal Finger Adjustment Condition, but 3-year-olds generally responded without comment whether they were in the Finger Adjustment Condition or not, Carey remarks that the tendency to respond without comment according to the context and the sentence-frame was "the natural propensity of 3-year-olds" (113). Carey concludes that "the child can generate a response with no input at all from a crucial lexical item" (121).

It is interesting to note that in both of Carey's experiments those children who questioned "What's tiv?" in response to the first instruction "Make it so it's tiv" were generally children who knew what less (and more) meant. This suggests that until the child is aware of what lexical items can be used in a particular context and sentence-frame, he will be more likely not to question words used in the instruction and, rather, to respond unquestioningly according to the contextual cues. Palermo (1973) similarly reports that the two children in his study that learned less in the course of the experiment "both commented that they did not know what less meant, . . .[and] indicated that they were puzzled by the word, and then both suddenly shifted from totally incorrect to totally correct performance" (219).

The movement from not knowing to knowing less may be a rapid one. Palermo (1973) found in his first experiment that the children fell into two groups, one with an average of 2.7 errors (out of 38 trials) on less (i.e., they knew less) and one with an average of 2.5 correct responses out of 38. Only one child fell between these two extremes. In his second experiment, few, if any, of the children (8 out of 96 Kindergartners through second graders) fell into an intermediate stage between ignorance of and knowledge of less. Palermo believes that these eight children, in fact, were not really in a transition stage, but only did better on less because of factors of boredom, fatigue, and inattention. Noting the paucity of subjects in transition, and commenting on the behavior of the two children who learned less in the course of the experiments, Palermo concluded:

> while a certain amount of preparatory experience may be necessary to acquiring the concept of less, the transformation occurs with an insightful suddenness. (219)

A rapid acquisition pattern for less is consistent with the conclusion that less never has an incomplete (or incorrect) lexical representation, [+Amount] or [+Amount, +Pol], before the child achieves an adult-like understanding of less. It is also consistent with Weiner's (1974) more general suggestion that there is no immature meaning for less before it means "smaller in amount." In Weiner's study, one of her hypotheses was that since children's early uses of more encode "occurrence," or the presence of an entity or entitities similar to an original, then there may be an early use of less which encodes "non-occurrence," or the absence of entitites. If so, young children should perform best on less when they see itmes being removed from a stimulus. However, her results showed that subjects did not show better performance on less when subtraction, rather than addition, was involved. This suggests that not only is less not ever understood as "more," but less is also not understood as "nonoccurrence" at any stage of development. The only meaning children ever attach to less is "smaller in amount."

More is Learned Before Less. Virtually all the studies on more and less conclude that children learn more before less. The only possible exception among the studies mentioned above is that of Harasym et al.

(1971), in which the semantic differential profiles of more and less for non-conservers in their study resembled the profile for less for logical conservers' understanding of more and less. However, Palermo's (1973) results showed an opposite effect in the semantic differential profiles of children in his study.[5] All other studies consistently report better results on more than on less. In addition, Wannemacher and Ryan (1978) give evidence that better performance on more also holds in the negative, for not more and not less (Wannemacher and Ryan 1978: 666).

In the light of the fact that children show a general non-linguistic response bias of adding or of choosing the greater of two or more arrays, it is important to consider whether responses to more are correct because of non-linguistic preferences or because of linguistic knowledge that more means /+Amount, +Pol/. The child could understand more in three different ways that would be consistent with correct responses to more. First, the child may have no, or an incorrect, lexical entry for more, coupled with a response bias which allows him to choose the greater of two arrays; secondly, the child may have a partial lexical entry for more, perhaps /+Amount/, coupled with such a non-linguistic response bias; thirdly, the child may actually know that more means /+Amount, +Pol/. Indeed, the child may move imperceptibly through these three stages, so that it may be quite difficult to determine at what point he knows the adult lexical entry for more. (See further discussion on pp. 118-123).

Despite the difficulty of pinpointing exactly when the lexical entry for more is filled in for the child and of discovering the time lag between this point and that at which less is filled in, there is some evidence that the entry for more is in fact filled in before that for less. Carey (1978a) noted that in her Experiment I (on 3- and 4-year-olds), responses of addition were over twice as frequent for more as for less or tiv (89% vs. 34% and 44%, respectively, pp. 113-116).[6] In addition, one group of children (n=7/65) treated more correctly, but treated less as they did tiv, as a nonsense syllable, giving an irrelevant or no response to instructions containing it. A similar group of children (n=7/29) was found in Gordon's two experiments (Gordon 1978: 16). In neither Carey's nor Gordon's study was there a corresponding group (of even one child) who responded to less correctly, but treated more as a nonsense syllable. It is argued that these results show that "the lexical entry for more plays a role in the generation of responses before the lexical entry for less does" (Carey 1978a: 120).

Even if the lexical entry for more plays a role in a child's responses to instructions before the lexical entry for less does, it must be noted that it does not necessarily follow that the lexical entry that the child has for more is adult-like. Indeed, studies like those of Donaldson and McGarrigle (1974) and Gordon (1978) (and Wannemacher and Ryan (1978) for less) have shown that the child responds differently to more in different contexts, which indicates he has not yet fully acquired the adult meaning of more. This leaves open the possibility that an adult-like lexical entry for more is not completely filled in until the child is also ready to fill in an adult-like entry for less.

Table 1

Ages of groups of children tested in individual more-less studies, arranged according to mean ages of subjects. Age ranges, shown with lines, and mean ages, shown with an "x," are given wherever reported. Dotted lines indicate that exact ages were not reported.

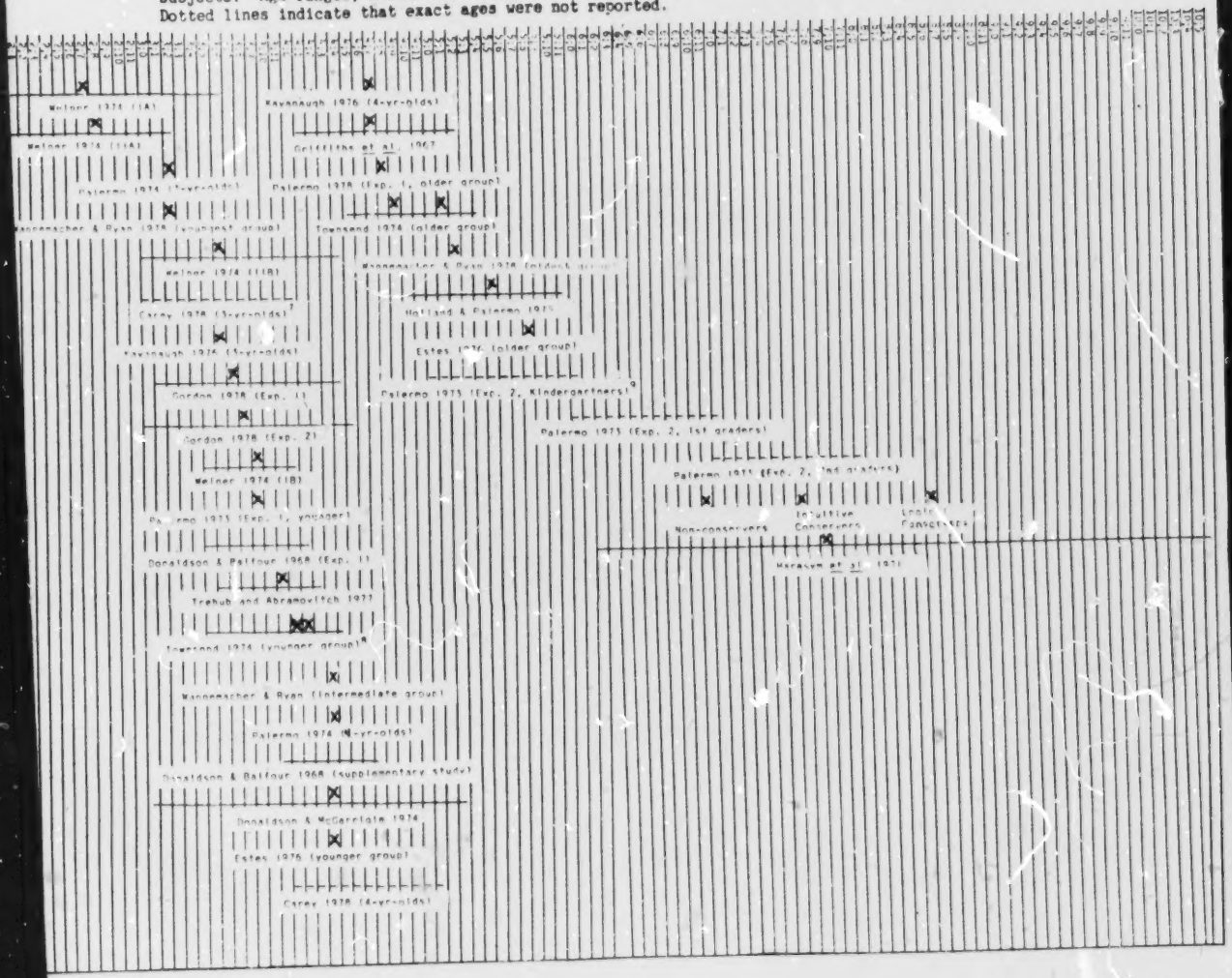
Kavanaugh 1976 (4-yr-olds)
Griffiths et al. 1967
Palermo 1978 (Exp. 1, older group)
Townsend 1974 (older group)
Holland & Palermo 1975
Estes 1976 (older group)
Palermo 1973 (Exp. 2, Kindergartners)
Palermo 1973 (Exp. 2, 1st graders)
Palermo 1973 (Exp. 2, 2nd graders)
Non-conservers
Transitive Conservers
Logical Conservers
Marcarm et al. 1971
Gordon 1978 (Exp. 1)
Gordon 1978 (Exp. 2)
Donaldson & Balfour 1968 (Exp. 1)
Trehub and Abramovitch 1977
Townsend 1974 (younger group)
Donaldson & Balfour 1968 (supplementary study)
Donaldson & McGarrigle 1974
Estes 1976 (younger group)
Carey 1978 (4-yr-olds)

Table 2

Overall performances of children in some studies of *more* and *less*, according to performance on *less* and mean age of group.

	Source	Group in Source	Mean Age	Performance on *less*	Performance on *more*
A.	Poor performance on *less*:				
1.	Weiner 1974[10]	IA	2;7	31-61% accuracy	33-57% accuracy
2.	Weiner 1974[10]	IIA	2;8	45-59% accuracy	56-84% accuracy
3.	Palermo 1974[11]	3-yr-olds	3;2	9/16 Ss did not know *less*; 5/16 Ss knew *less*.	N.A.
4.	Wannemacher & Ryan 1978[12]	youngest group	3;2	mostly chance on *less*: (Tasks 2-6; 90% accuracy on Task 1)	97% (Task 1)
5.	Weiner 1974[10]	IIB	3;6	61-72% accuracy	82-87% accuracy
6.	Kavanaugh 1976[13]	3-year-olds	3;6	1-15% accuracy	81-99% accuracy
7.	Gordon 1978[14]	Exp. 2	3;8	48% accuracy	82.2% accuracy, but 6/20 Ss made about 50% errors
8.	Weiner 1974[10]	IB	3;9	47-53% accuracy	94-99% accuracy
9.	Palermo 1973[15]	Exp. 1, younger	3;9	4/16 Ss knew *less*	14/16 Ss made fewer than 5/38 errors
10.	Donaldson & Balfour 1968, Donaldson & Wales 1970[16]	1st Exp.	3;5-4;1	13/14 Ss treated *less* as "more"	Ss responded correctly to *more*.
11.	Trehub & Abramovitch 1977[17]		3;11	10/18 Ss made errors on *less*; 87.5% of their *less* responses were "more" responses.	71/80 correct responses by the 10 Ss making any errors; 137/144 correct responses by all Ss.
12.	Townsend 1974[18]	younger	4;0 or 4;1	44-56% accuracy	94-97% accuracy
13.	Donaldson & Balfour 1968[16]	suppl. study	3;11-4;7	41/52 responses to *less* were additions.	N.A.
14.	Kavanaugh 1976[13]	4-yr-olds	4;7	54% accuracy	90-94% accuracy
15.	Palermo 1973[15]	Exp. 1, older	4;8	5/16 Ss knew *less*.	All Ss made fewer than 5/38 errors.
16.	Townsend 1974[18]	older	4;9 or 5;0	44-58% accuracy	61-94% accuracy
17.	Palermo 1973[15]	Exp. 2, Kinderg.	5;6	25/32 Ss treated *less* as "more"; 3/32 knew *less*.	All Ss knew *more*.
B.	Performance on *less* better than chance:				
18.	Gordon 1978[14]	Exp. 1	3;7	80.6% accuracy	87.5% accuracy, but 3/9 Ss made about 50% errors
19.	Wannemacher & Ryan 1978[12]	intermed.	4;3	73-94% accuracy on all tasks except Task 2, Q 2, & Task 3, on which Ss responded at chance.	97% accuracy on Task 1
20.	Palermo 1974[11]	4-yr-olds	4;3	10/16 Ss knew *less*; 5 did not.	N.A.
21.	Griffiths et al. 1967[19]		4;7	85% accuracy	88% accuracy
22.	Wannemacher & Ryan 1967[12]	oldest	5;3	87-100% accuracy on all tasks except Task 2, Q 2, at chance	100% (Task 1)
23.	Palermo 1973[15]	Exp. 2, 1st	@ 6;6	20/32 Ss knew *less*; 9 did not.	All Ss knew *more*.
24.	Palermo 1973[15]	Exp. 2, 2nd	@ 7;6	25/32 Ss knew *less*; 6 did not.	All Ss knew *more*.

Various reasons have been proposed for the prior acquisition of more. First of all, more is more frequent than less in adult speech (Weiner 1974, Donaldson and Balfour 1968). Donaldson and Wales (1970) felt that this was an unlikely determinant, since children could be expected to be perplexed at less if they were merely unfamiliar with it. However, this has been shown to be a faulty assumption. (See pp. 112-113 above.) Secondly, Weiner (1974) has pointed out that the child's early understanding of more is simpler than his first understanding of less. Since she did not find an early "nonoccurrence" meaning for less which might correspond to children's early "occurrence" uses of more, she concluded that the first meaning of less is "smaller in amount," a much more complex notion than the early "occurrence" sense of more. A third explanation for the prior acquisition of more is related to the child's non-linguistic preference for the greater of two amounts. Estes (1976) has shown that non-verbal discrimination between more and fewer elements is more easily learned when the stimulus with more elements is positive (i.e., the correct response). Estes suggests that this "feature positive effect," by which the discrimination of two stimuli is facilitated when the feature distinguishing them is present on the positive stimulus, may be operating to encourage the prior acquisition of more. However, she adds that the prior acquisition of more may instead merely be a reflection of an initial response bias or preference for greater magnitudes, rather than a difference in the learning process.

Developmental Sequence. One difficulty in generalizing from the available literature is the vast range in age groups studied. The studies discussed above deal with children from 2;1 up to 10;5. The ages examined in each study are shown in Table 1. It is important to bear children's ages in mind when considering the findings of these studies, since age differences such as those shown in Table 1 may affect children's responses. This is true whether there is a continual upward progression in children's development or there are periods of reorganization or reanalysis, whereby an older group of children might perform more poorly on a given item than their younger counterparts.

There are dangers in comparing the figures in one study with those in another because of differences in procedures, emphases, and populations of subjects. However, because studies of more and less have been so abundant, we can more confidently compare their general overall findings in an attempt to get a broader view than any individual study affords. If we keep in mind that the explanations underlying the individual findings are as important as the findings themselves, we can pull out the overall results of individual studies and arrange them according to the ages of the subjects tested. This is done in Table 2. Figures from each study were either drawn directly from the texts or extrapolated from the data in the texts. [20]

Less: In A of Table 2, a majority of the children in a particular age group in a study were found to respond incorrectly to less, or the overall performance of children in an age group was at chance or worse than chance level on less. In B of Table 2, a majority of the children

in a particular age group in a study were reported to respond correctly to less, or their overall performance was better than chance on less.

Looking at the results shown in Table 2, we can surmise that a critical period for the acquisition of less for a majority of children seems to fall somewhere near the middle of the fifth year.[21] The youngest groups for which performance on less was better than chance had mean ages of 3;7 and 4;3. The oldest known age groups who did not know less had mean ages of 4;8, and 4;9 or 5;0. Note that Carey (1978a), not reported in Table 2, found that 41% of her 3-year-olds fell into the group in her study which showed no lexical entry for more or less; 42% of the 4-year-olds had already learned both more and less.

If the middle of the fifth year does mark a turning point for most children's performance on less, it helps to clear up some of the anomalies in results on more and less in different studies. For example, the mean age of children in Griffiths et al.'s (1967) study, in which subjects did well on less, was 4;7. And in Holland and Palermo's (1975) study, in which subjects with mean age of 5;5 were trained on less, the children learned less with surprising speed and ease (441).

More: Table 2 also shows children's performance on more in each study, according to age group. It appears that, except for the youngest children in Weiner's study, and those in Donaldson and McGarrigle's and Gordon's studies, most children perform well on more. On the whole, there is no noticeable difficulty or any reported decrement in children's performance on more.

What does this finding indicate? The absence of a reported or perceptible difficulty or decrement in most of these studies indicates one of four things.

(1) A child learns the correct meaning for more from the beginning.
(2) A child learns a partially correct interpretation for more from the beginning and progression is always upward.
(3) A child learns a partially correct interpretation for more from the beginning and must reanalyze the meaning as he gains a more complete understanding of more, but the reanalysis, which could be expected to yield late-emerging errors, is not reflected on the surface in these studies because of other overriding influences on responses, such as a non-linguistic response bias in favor of greater amounts.
(4) A child learns a partially (or totally) incorrect interpretation for more from the beginning and must relearn or reanalyze its meaning, but this is not reflected on the surface in these studies because of other overriding influences on responses.

I think we can safely reject the first possibility. Even though we have by now rejected the notion that less ever has an immature meaning for the child, it does not preclude the possibility that more ever has an immature lexical entry for children. Indeed, there is evidence that very young children often do not use more to mean "greater in amount" but, rather, "occurrence" or "some." In addition, the lack of difficulty

with more in most studies finds notable exception in studies such as Donaldson and McGarrigle's (1974) and Gordon's (1978). In Donaldson and McGarrigle's study, subjects had difficulty with more in reference to numbers of cars in filled vs. unfilled garages. In Gordon's study, though overall accuracies on more were high (87.5% and 82.2% in Experiments 1 and 2, respectively), a sizable proportion of the children (9/29) in his two experiments made incorrect or inconsistent responses to more on at least half the items tested. (See footnote 14.) These both show dramatically that though older children can respond correctly to more in some contexts, in others they cannot. If children acquired more correctly and fully from the beginning, this would never be the case.

The fourth possibility above, though more plausible than the first, seems less tenable than either the second or third possibility. There is really no evidence that the child ever has postulated an incorrect meaning for more. Indeed, children's incorrect responses to more are often seen to have their sources in adult usage. For example, Weiner (1974) points out that the "occurrence" sense of more corresponds to adult usage in cases such as "Here is one rack of dresses, and there are more dresses over there" (273). Gordon (1978) makes a similar point in reference to a child's responses when shown two groups of wooden blocks, one with many small and thin blocks, the other with fewer very large blocks. If the child attends to the amount of matter, rather than the number of blocks, as Gordon suggests some children may have done in his study, he will respond incorrectly to "Which X has more blocks of wood?" However, the child's choice would be a correct interpretation of "Which X has more wood?" (24). The child's attendance to mass instead of number produces mistakes in the former case, but it is a potentially correct use of more found in the adult mode .

I am inclined to believe that the initial uses of more fall into either the second or third possibilities. Since it is difficult at this point to choose between those possibilities, let us consider their common hypothesis--that the child begins with a partially correct interpretation for more from the beginning. What form might this partial understanding of more take? We can discern at least six possibilities, according to the interaction of the nature of the child's linguistic knowledge and the role of the context in his use(s) of more.

(1) The child knows that more means /+Amount/, and non-linguistic response strategies allow him usually to choose the correct, greater referent until /+Pol/ is added to his linguistic knowledge.
(2) The child knows that more means /+Amount/, and the context determines the referent--e.g., whether more applies to "fullness" or "length," mass or number. Note that (1) and (2) are not mutually exclusive.
(3) The child knows that more means /+Pol/, and the context determines the "dimension" of application (e.g., mass instead of number, fullness instead of length).

(4) The child has a vague notion of the meaning of more, and decides in each context on the appropriate application of more.

(5) The child knows several different "more's," each appropriate to different contexts (e.g., relative fullness, relative length, etc.); he must later learn to integrate these into a single semantic unit.

(6) The child learns more in reference to a prototypical context or referent, and he applies it to new contexts on the basis of which aspects of the prototype are present.

Besides the possibility that any one of these reflects the initial stage of a child's understanding of more, it is also possible that (4), (5), or (6) is an initial stage that grows into an intermediate stage described by (1), (2), or (3).

It is at this point extremely difficult to choose among the above possibilities. The Partial Semantic Feature Hypothesis predicted that (1) above was correct, though it would not be inconsistent with (2). Recall that according to the Partial Semantic Feature Hypothesis, more means initially /+Amount/, or "some," and the best exemplar of /+Amount/ is the item with the greatest amount. Though the Partial Semantic Feature Hypothesis held that both more and less initially mean /+Amount/, it is possible that more means /+Amount/ at an early stage even if less never does. In fact, Weiner, whose data revealed no confusion of less with more, has suggested that perhaps there is a period at which more means "a lot." She made this suggestion on the basis of an accidental observation in her study. Weiner discovered that if 3-year-olds were asked "Which row has more?" after items had been added to or subtracted from one of two rows of unequal numbers of items, the performance was much better when the initial rows differed by a great number (differing by 5 items) than when they differed by a small number (differing by only 1 item in the other condition (78% and 87% correct vs. 61% and 61% correct, 280-281). She notes that in one of such conditions fostering better performance on more, the "less" row had only one item (vs. 6 in the "more" row), and in the other condition, the "more" row had nine items (vs. four in the "less" row), taking up the whole shelf on which the items were placed.

This observation must be viewed in the light of Estes' (1976) finding in her study of nonverbal discrimination of more and fewer elements that "the larger the numerical discrepancy between . . . [two stimuli], the easier it is to learn to choose the correct stimuli" (397). It is difficult to ascertain what the exact relationship between this cognitive ability to better distinguish great numerical discrepancies and the acquisition of more is. Do large numerical discrepancies simply make it easier to respond correctly to more in conditions like those discussed by Weiner, no matter what the lexical meaning of more is for the child? Does the cognitive ability to better distinguish great numerical discrepancies facilitate the acquisition of more first in reference to great differences? Is there a point at which more actually means "a lot" before it means "greater in amount" because it is learned first in

reference to great differences--i.e., cases where more refers to an amount that is a lot--rather than small differences--i.e., cases where more refers to a small or not remarkably large amount?

Donaldson and McGarrigle proposed that (4) above is correct; they hypothesized a set of "local rules" used by the child to help him interpret the referent of more in a particular context. They describe how these local rules interact with lexical rules (related to the meaning of a word) and syntactic rules (related to the interpretation of a word in a given sentence):

> Their precise function is to determine those features of the referent which will be selected as criteria for the assigning of truth values when the linguistic rules leave the matter vague. They are hierarchically ordered. Thus they may specify that fullness takes preference over length, length over density and so on, when situations arise where these are left as possible criteria by the rules of the lexicon and of the grammar. (193).

Gordon expands on this notion, commenting that the application of more may be indexical to a greater degree for the child than for the adult.

> Thus the question may not just be one of what lexical entry the child has for more and the generality of the lexical items presented, but more important, the ability of the child to map the reference term onto the relevant feature differences and the nature of the particular features present which may vary in significance according to the 'local rules' obtaining. (25)

Since Donaldson and McGarrigle add that they conceive of these local rules "as being contingent on predispositions to structure or interpret the world in particular ways which are 'natural' for human beings" (194), it is not clear why these should be postulated as 'rules' rather than 'intuitive' response biases which the child relies on in the absence of other (here, linguistic) criteria he can use in responding to instructions.

The sixth possibility, that there is a prototypical more for the child, is related to the fourth. The difference would be that instead of hierarchically ordered local rules for applying more in each context, the preferred uses of more--i.e., fullness over length, length over density, etc.--would reflect the relative importance of the "features" of the prototypical more. Though these two possibilities are extremely difficult to examine empirically, one could possibly decide between them on the basis of cross-linguistic data if one could find two languages in which the adult uses of more, especially in speech to children, differed significantly. In such a case, (4) would predict that more would be used in much the same way by children learning those two languages. However, (6) would predict, if we assume that the child's prototypical uses of more are drawn from adult usage, that the children learning those two languages would use more in new instances differently.

The fifth possibility above is similar to that explanation for children's differential response patterns to more in different contexts that Donaldson and McGarrigle wished to avoid. They contend that their "local rules" are the only alternative

> to supposing that for young children 'the meaning' of an utterance frequently changes . . . . If we do not introduce some such notion [like local rules] we are forced . . . to conclude that, for the children, a complex set of alternative meanings inheres in the language itself; and we are then still left with the task of explaining why one meaning tends to be systematically preferred in a particular instance (194).

It should be noted that these two possibilities are not the only ones that will explain systematic preferences in the application of more in distinct contexts. They are equally explainable if the child postulates a prototypical meaning for more, since it has been argued that at least in some cases of the acquisition of word meaning, certain features of the prototype appear to be "more central or concept-defining . . . than others" (Bowerman 1978: 282).

The last of the above possibilities, number (3), has been suggested by Gordon (1978). In his study, in which 9/29 3- and 4-year-olds were either incorrect or inconsistent in their responses to more at least 50% of the time, he noted that errors were usually ones of choosing a /+Pol/ item. The stimuli in his experiments were pairs of sets of items that differed not only in number, but also in other features, such as color, size, shape, and homogeneity. Gordon noted that subjects' incorrect responses to more consisted largely of choices of three-dimensional over two-dimensional items, bigger over smaller items, and heterogeneous sets of colors, shapes, or types over homogeneous sets. He postulates that these choices all represent choices of /+Pol/ items, with the incorrect "dimension" (e.g., mass instead of number). As Gordon notes, this ties in with the recent hypothesis (Carey 1978b) that in the child's acquisition of spatial adjectives, /±Pol/ is filled in for each adjective long before the appropriate dimension.

It is premature at this point to choose among the above six possibilities. We can only do so with the aid of additional empirical evidence. The primary emphasis in studies of more and less to date has been the meaning of less. Researchers must now turn to these questions about the meaning of more.

Returning now to the apparent absence of difficulty or decrement in children's responses to more in most studies, we can conclude that this is most likely due to a large extent on the nature of the tasks required of the subjects. In all the studies except Donaldson and McGarrigle's and Gordon's, the only difference between any two sets of stimuli was one of number or sizes of masses. Even if the children had an immature understanding of more, they could easily respond correctly in such tasks. Whether they responded on the basis of a non-linguistic preference for the greater of two arrays, on the basis of "local rules" which would help

them understand more in the given context, on the basis of one of several more's they had learned, or on the basis of a prototypical more which included a "feature" relating to differences in number or size of masses, it would be clear to them that the relevant feature of the context in all these studies was a difference in number or size of masses, since this was the only difference between the stimuli shown. Success on more, therefore, has been built into such studies. Studies like Donaldson and McGarrigle's and Gordon's, on the other hand, in which differences other than differences of amount were available, presented the child with ambiguous contexts, in which more could be applied in various ways, and results show that children's knowledge of more is not so mature as other studies might have suggested.

Conclusion

The acquisition of an adult-like understanding of more appears to take years of development. Most children at the two-word stage produce utterances with more, but even as late as 5;5 some children still do not fully understand more (Donaldson and McGarrigle 1974). This contrasts sharply with evidence that less is learned suddenly, and with its proper /+Amount, -Pol/ meaning from the start.

Gordon (1978) has postulated a developmental sequence which would help explain this difference between more and less. Pointing out that a correct understanding of more (and less) involves knowledge of the lexical item itself, cross-reference between more (less) and the type of noun or object referred to (e.g., wood or blocks of wood), and the ability to map this onto the situation presented, he hypothesizes that

> the order of developments goes from: 1) more being represented positively, but [the child shows] an inability to relate text to context correctly in ambiguous situations. 2) More being correctly represented as (+) quantity, (+) pole, and the child is able to pick out the relevant features in the context. 3) Less being recognized as the polar opposite of more and requiring similar strategies in picking out the correct features. (27)

As discussed above, it is possible that the child's initial and intermediate understandings of more take a form other than those described by Gordon. However, all evidence seems to point to what Gordon describes in his step (3). The acquisition of more involves the complex process of learning the meaning of more, learning how to relate it to the type of noun, and learning how to map this onto the context of the utterance. Once these are worked out for more, however, less can quickly fall into place as the polar opposite of more and as a word which, therefore, requires the same complex set of operations for its correct use as more does.

There is still much left for us to discover about the acquisition of more and less, but especially about more. We do not really know much about how an adult-like understanding of more is acquired. A few hypotheses have been made and tested concerning its development, but with discouraging results. For example, Weiner has experimentally tested the possibility that the child's evolving understanding of more from an "occurrence" sense to the adult "quantity" sense may be facilitated by the process of adding elements, in that the "occurrence" of an object when being added to a group of items leads to a greater number of items. However, she found no support for this hypothesis.

In addition, the emphasis so far in studies has been on the pronominal and adjectival uses of more and less; little is known about the acquisition of adverbial uses of more and less or about when and how the child learns that more and less are related to the -er comparative.

Another mystery to us is how and when the child learns that more corresponds to both much (mass) and many (count) as their mutual comparative form, and that less corresponds to little (mass) and few (count). There are some hints in Gordon's (1978) study that children may learn more as the comparative of much, referring to relative amounts of masses, before they learn it as the comparative of many, referring to relative numbers of elements.

Further research is needed to clarify such issues as these, but if researchers prove to be as prolific in answering these questions as they have been on previous questions about the acquisition of more and less, we can look forward to much informative and fruitful work in the near future.

FOOTNOTES

1 All the studies reported here treat less as the only opposite of more, whether they are testing these terms in reference to mass or count nouns. In some dialects of English, the opposite of more when referring to count nouns is fewer. In these dialects, the [-Pol] end of the scale is more complex than the [+Pol] end, in that the negative-pole distinction between mass and count nouns is neutralized in the positive-pole quantifier, more. It should be noted perhaps that one study in which both less and fewer were tested as opposites of more was Townsend's (1976) study of children's comprehension of the comparative forms of opposite-pole antomyms. Townsend reported that his subjects, aged 2;6 to 4;0, performed with the same accuracy on less and fewer. In addition, the responses to these 2 words did not differ in overall frequency of opposite-pole ("more") responses. (Townsend 1976: 386-88)

2 Authors vary in their use of /±Polar/, /±Pole/ and /±Pol/. To avoid confusion, we will use /±Pol/ for all studies.

3 Later results of Wannemacher and Ryan (1978) suggest that in Donaldson and McGarrigle, the subjects may have been focusing on the garages "containing" or not completely "containing" the cars, rather that on a less specific "completeness" or "non-completeness" of the display. In Wannemacher and Ryan's study, one task required of the children involved judging which of two or more vertical rods of beads had more (less) beads than a standard. The task was administered on six different displays, all of which had at least one rod containing 1 1/2 inches of beads, at least one containing 4 1/2 inches of beads, and at least one standard containing 3 inches of beads. One of the variables in the six displays was the length of each rod relative to the height of the beads on it. (The other two variables were the removability of the rod chosen, and the number of rods in the display (3 to 6).) Unfortunately, only one of the displays had rods that were exactly the same height as the beads on the rod, while the other 5 displays all had rods 4 1/2 inches tall. However, Wannemacher and Ryan report that there was no significant difference "among the six arrays in percent correct as a function of either replacement versus non-replacement or the number of response alternatives in the array" (663). Since they do not discuss differences in results from the six displays further, it is assumed that this also means that there was no significant difference as a function of the height of the rods relative to the height of the beads on them.

4 In fact, Wannemacher and Ryan (1978) found that when they varied the number of explicit response alternatives in the six displays of their Task I, this had no effect on the percentage of correct responses.

5 It may be significant that the children in the Harasym et al. study were quite a bit older than those in Experiment 2 in Palermo's (1973) study.

6 However, we must voice some reservations about this conclusion. It should be noted that when the subjects who knew more and less (Carey's Groups II and IV) in Experiment I are eliminated from the overall figures of addition for more, less, and tiv, the differences are not so striking: 80.5%, 61%, and 69.5% additions for more, less, and tiv, respectively. It is perhaps significant that these figures show more and less about equally different from the nonsense syllable tiv, each in the direction of the appropriate pole. Perhaps those children who did not know more and less really knew as little linguistically about more as they did about less.

7 Carey (1978a) reports that her subjects were 3- and 4-year-olds, but does not provide more specific details.

8 Townsend (1974) performed two experiments, one on more/less, the other on taller/shorter, on four groups of children, for which he reports mean ages. However, it is not clear which mean ages correspond to the subjects in the more/less condition.

9 Palermo (1973) does not report the exact age ranges or mean ages of his subjects. He reports that they were in Kindergarten, first, and second grades. It is assumed that these subjects fall somewhere between 5;0 and 8;0, with mean ages of around 5;6, 6;6 and 7;6 for each grade.

10 Weiner 1974, p. 279, Table 2.

11 Palermo 1974, p. 829.

12 Wannemacher and Ryan 1978, p. 663, Table 1 (Task 1); p. 664, Table 2 (Task 2); p. 665 (Task 3); p. 665, Table 3 (Task 4); p. 665 (Task 5); p. 666 (Task 6). Note: More was tested only in Task 1.

13 Kavanaugh, 1976, p. 886.

14 Gordon 1978, pp. 14-16, 20. For more, Gordon reports on pp. 14 and 15 that 5/9 and 10/20 subjects made an average of about 50% errors in Experiment 1 and Experiment 2, respectively. In p. 16, Table 1, and p. 20, he reports that 9/29 total subjects (3/9 and 6/20 in Experiments 1 and 2, respectively) made incorrect or inconsistent responses to more on at least half the items tested. We are reporting the more conservative numbers, since even these show a sizable proportion of subjects not knowing more.

15 Palermo 1973, p. 214 (Experiment 1) and p. 217 (Experiment 2).

16 Donaldson and Balfour 1968, p. 464 (information on more, first experiment) and p. 467 (information on supplementary study.) Donaldson and Wales 1970, p. 246 (information less, first experiment).

17 Trehub and Abramovitch 1977, pp. 163-164 (data on less) and p. 163, (data on more).

18 Townsend 1974, p. 297, Table 1. Note: Data for Townsend's "SP" type are not included, since this type of sentence--e.g., "Who has more (less) apples than he has oranges?"--proved extremely difficult for all children.

19 Griffiths et al. 1967, p. 844.

20 Of the experimental studies shown in Table 1, the following are excluded from Table 2, either because the authors do not report overall percentages by age groups, because the results are not easily transcribed into numerical results, or because the focus of the study was not primarily quantitative or did not concern less: (1) Harasym et al. 1971, (2) Carey 1978a, (3) Holland and Palermo 1975, (4) Donaldson and McGarrigle 1974, and (5) Estes 1976.

21 The exact age of the acquisition of less for any particular child is probably related to some degree with his intellectual development. Palermo (1973) noted that the preschoolers in his Experiment 1 did better than the Kindergartners in his Experiment 2 and commented that the acquisition of less is very likely dependent on a child's intellectual ability (p. 218). Likewise, Gordon's subjects in his Experiment 1 performed far better than those in his Experiment 2, and he noted that the first group's IQ scores were way above average (p. 15).

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